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Standard Mathematical Tables

Twenty-fourth Edition

Editor of Mathematics and Statistics

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DESCRIPTIVE STATISTICS

a) Ungrouped Data

The formulas of this section designated as *a*) apply to a random sample of size n, denoted by x_i, $i = 1, 2, \ldots, n$.

b) Grouped Data

The formulas of this section designated as *b*) apply to data grouped into a frequency distribution having class marks x_i, $i = 1, 2, \ldots, k$, and corresponding class frequencies f_i, $i = 1, 2, \ldots, k$. The total number of observations given by

$$n = \sum_{i=1}^{k} f_i$$

In the formulas that follow, c denotes the width of the class interval, x_o denotes one of the class marks taken to be the computing origin, and $u_i = \frac{x_i - x_o}{c}$. Then coded class marks are obtained by replacing the original class marks with the integers $\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots$ where 0 corresponds to class mark x_o in the original scale.

Mean (Arithmetic Mean)

$$a)\ \bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i = \frac{x_1 + x_2 + \cdots + x_n}{n}$$

$$b.1)\ \bar{x} = \frac{1}{n}\sum_{i=1}^{k} f_i x_i = \frac{f_1x_1 + f_2x_2 + \cdots + f_kx_k}{n}$$

If data is coded

$$b.2)\ \bar{x} = x_o + c\,\frac{\sum_{i=1}^{k} f_i u_i}{n}$$

Weighted Mean (Weighted Arithmetic Mean)

If with each value x_i is associated a weighting factor $w_i \geq 0$, then $\sum_{i=1}^{n} w_i$ is the total weight, and

$$a)\ \bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} = \frac{w_1x_1 + w_2x_2 + \cdots + w_nx_n}{w_1 + w_2 + \cdots + w_n}$$

Geometric Mean

$$a)\ \text{G.M.} = \sqrt[n]{x_1 \cdot x_2 \cdots x_n}$$

In logarithmic form

$$\log\,(\text{G.M.}) = \frac{1}{n}\sum_{i=1}^{n} \log x_i = \frac{\log x_1 + \log x_2 + \cdots + \log x_n}{n}$$

b) $\text{G.M.} = \sqrt[n]{x_1^{f_1} \cdot x_2^{f_2} \cdots x_k^{f_k}}$

In logarithmic form

$$\log\,(\text{G.M.}) = \frac{1}{n}\sum_{i=1}^{k} f_i \log x_i = \frac{f_1 \log x_1 + f_2 \log x_2 + \cdots + f_k \log x_k}{n}$$

Harmonic Mean

a) $\text{H.M.} = \dfrac{n}{\sum_{i=1}^{n} \dfrac{1}{x_i}} = \dfrac{n}{\dfrac{1}{x_1} + \dfrac{1}{x_2} + \cdots + \dfrac{1}{x_n}}$

b) $\text{H.M.} = \dfrac{n}{\sum_{i=1}^{k} \dfrac{f_i}{x_i}} = \dfrac{n}{\dfrac{f_1}{x_1} + \dfrac{f_2}{x_2} + \cdots + \dfrac{f_k}{x_k}}$

Relation Between Arithmetic, Geometric, and Harmonic Mean

$\text{H.M.} \leq \text{G.M.} \leq \bar{x}$, (Equality sign holds only if all sample values are identical.)

Mode

a) A mode M_o of a sample of size n is a value which occurs with greatest frequency, i.e., it is the most common value. A mode may not exist, and even if it does exist it may not be unique.

b) $M_o = L + c\,\dfrac{\Delta_1}{\Delta_1 + \Delta_2}$,

where L is the lower class boundary of the modal class (class containing the mode),
Δ_1 is the excess of modal frequency over frequency of next lower class,
Δ_2 is the excess of modal frequency over frequency of next higher class.

Median

a) If the sample is arranged in ascending order of magnitude, then the median M_d is given by the $\dfrac{n+1}{2}$ *nd* value. When n is odd, the median is the middle value of the set of ordered data; when n is even, the median is usually taken as the mean of the two middle values of the set of ordered data.

b) $M_d = L + c\,\dfrac{\dfrac{n}{2} - F_c}{f_m}$,

where L is lower class boundary of median class (class containing the median),
F_c is the sum of the frequencies of all classes lower than the median class,
f_m is the frequency of the median class.

Empirical Relation Between Mean, Median, and Mode

$$\text{Mean} - \text{Mode} = 3\,(\text{Mean} - \text{Median})$$